

DESCRIPTION

Title of Invention

BUILDING STRUCTURE

Technical Field

[0001]

The present invention relates to a building structure.

Background Art

[0002]

JP 2006-299534 A (hereinafter referred to as literature 1) discloses a conventional building structure. In this conventional building structure, multiple structures, in each of which a beam is placed over multiple columns, are placed in a direction perpendicular to a longitudinal direction of the beam with being spaced at certain intervals. The multiple structures are connected with each other by a lot of purlins elongating in the direction perpendicular to the longitudinal direction of the beam. Then, an outer roof material is placed over the purlins.

[0003]

In the building structure disclosed in literature 1, the beams are connected by a lot of purlins. Due to this, the conventional building structure requires work done by workers to connect the beams using a lot of purlins and also requires material costs for a lot of purlins.

Summary of Invention

[0004]

The present invention aims to provide a building structure which can have strength without purlins.

[0005]

A building structure according to one embodiment of the present invention includes: a plurality of support structures each including a plurality of columns and a beam attached to the plurality of columns, wherein the plurality of support structures are placed with being spaced at certain intervals in a ridge direction; and a sandwich panel which connects the beams with each other.

[0006]

In the building structure, the beam preferably includes: a pair of truss chords including an upper truss chord and a lower truss chord placed separately; and a plurality of connecting materials which connect the pair of truss cords, and the sandwich panel is preferably fixed to the upper truss chord.

[0007]

Also, in the building structure, the sandwich panel preferably includes: a lower metal skin which is fixed to the beam; an upper metal skin which is placed above the lower metal skin with being spaced from the lower metal skin; and a core provided between the lower metal skin and the upper metal skin, and the upper metal skin preferably has a protrusion which is a continuous protrusion along the ridge direction and protrudes throughout the ridge direction of the upper metal skin.

Brief Description of Drawings

[0008]

[FIG. 1] FIG. 1 is a perspective view of a partially disassembled building structure according to one embodiment of the present invention.

[FIG. 2] FIG. 2 is a perspective view of a main part of the above building structure.

[FIG. 3] FIG. 3 is a front view of a sandwich panel of the above building structure.

Description of Embodiments

[0009]

Hereinafter, one embodiment of the present invention is explained referring to the attached drawings.

[0010]

A building structure of the present embodiment can constitute, for example, a building such as a factory and a warehouse. The building structure includes, as illustrated in FIG. 1, a plurality of support structures 1 and a plurality of sandwich panels 4 which connect the plurality of support structures 1. Since the plurality of support structures 1 are connected by the plurality of sandwich panels 4 having high mechanical strength in the building structure of the present embodiment, a lot of purlins used in conventional building structures can be omitted.

[0011]

Each of the plurality of support structures 1 includes a pair of columns 2 and a beam 3 which connects upper parts of the pair of columns 2. The pair of columns 2 and the beam 3 are rigidly jointed and the support structure 1 constitutes a so-called Rahmen structure. The plurality of support structures 1 are placed with being spaced at certain intervals in a direction (also referred to as a ridge direction) which is a direction perpendicular to a longitudinal direction of the beam 3 (the longitudinal direction may be also referred to as a beam direction) and parallel to a horizontal plane.

[0012]

Each of the pair of columns 2 is in a form of a quadrangular prism elongating in a vertical direction. Each columns 2 is formed of reinforced concrete and having a so-called RC (Reinforced-Concrete) structure. The pair of columns 2 is facing each other with being spaced in the beam direction at a certain interval. Note that each support structure 1 may include at least one pair of columns 2 and may additionally include an auxiliary column between the pair of columns 2 as illustrated in FIG. 1.

[0013]

The beam 3 is placed over the plurality of columns 2 and elongates in a horizontal direction. The beams 3 in the plurality of support structures 1 are parallel to each other. Each beam 3 includes a pair of truss chords 31 and a plurality of connecting materials 34, as illustrated in FIG. 2.

[0014]

The pair of truss chords 31 elongates in the horizontal direction. In the present embodiment, the pair of truss chords 31 includes an upper chord 32 and a lower chord 33. The lower chord 33 has a pair of flanges 334 and a groove 331 whose cross section has a substantial U shape. The lower chord 33 is formed so that a cross section of the lower chord 33 has a hat shape. The groove 331 includes a horizontal part 332 which has a width in the ridge direction and a pair of vertical parts 333 which elongates down from both widthwise edges of the horizontal part 332. Each flange 334 elongates outward along the horizontal direction from a bottom edge of each vertical part 333. The pair of flanges 334 is formed respective to the pair of vertical parts 333 so that each flange 334 corresponds to each vertical part 333.

[0015]

The lower chord 33 is fixed to an upper surface of each column 2. Specifically, the lower chord 33 is fixed to the upper surface of each column 2 by, for example, bolting the flanges 334 to each column 2.

[0016]

The upper chord 32 is placed above the lower chord 33 with being spaced at a certain interval. The upper chord 32 and the lower chord 33 are placed separately in the vertical direction. The upper chord 32 is placed so that the upper chord 32 overlaps with the lower chord 33 looking from the above (in a plan view). The upper chord 32 has a pair of flanges 324 and a groove 321 whose cross section has a substantial U shape. The upper chord 32 is formed so that a cross section of the upper chord 32 has a hat shape. The groove 321 includes a horizontal part 322 which has a width in the ridge direction and a pair of vertical parts 323 which elongates upward from both widthwise edges of the horizontal part 322. Each flange 324 elongates outward along the horizontal direction from an upper edge of each vertical part 323. The pair of flanges 324 is formed respective to the pair of vertical parts 323 so that each flange 324 corresponds to each vertical part 323.

[0017]

The upper chord 32 and the lower chord 33 are connected by the plurality of connecting materials 34. The plurality of connecting materials 34 include a vertical material 341 which elongates in the vertical direction and a diagonal material 342 which is inclined with respect to the vertical direction. A top part of each connecting material 34 is pin jointed by, for example, using a bolt to each vertical part 323 of the upper chord 32. Also a bottom part of each connecting material 34 is pin jointed by, for example, using a bolt to each vertical part 333 of the lower chord 33. The plurality of connecting materials 34 are jointed to each of the pair of vertical parts 323, 323 (333, 333) provided separately in the ridge direction. Each of the connecting materials 34 may be, for example, a C-shaped steel including: a web 35 which is pin jointed to the upper chord 32 and the lower chord 33; and a pair of flanges 36 which projects from edges of the web 35.

[0018]

The beam 3 having the above explained structure is rigidly jointed to the upper surface of each column 2 by, for example, using multiple bolts. Due to this, the support structure 1 of the present embodiment can constitute the Rahmen structure as explained above. The plurality of

support structures 1 of the present embodiment are connected by the sandwich panel 4 having a roof surface, and the beams 3 are not connected by purlins. Therefore, the purlins required in a large number in the conventional building structures can be omitted in the building structure of the present embodiment, and the building structure of the present embodiment is excellent in workability as well as in cost.

[0019]

The sandwich panel 4 can maintain the mechanical strength such as bending strength and tensile strength due to metal boards placed separately in the vertical direction. Also, since the sandwich panel 4 includes a core 43 having a heat insulating property, additional heat insulating materials do not need to fill in space between the purlins and a roof material. As illustrated in FIG. 3, the sandwich panel 4 includes a lower metal skin 41, an upper metal skin 42, and the core 43.

[0020]

The lower metal skin 41 has a width in the beam direction and a length in the ridge direction. The lower metal skin 41 is placed over an upper surface of the truss chord 31 (over the flanges 324 of the upper chord 32). The lower metal skin 41 includes a plurality of recesses 411 elongating in the ridge direction. Each of the plurality of recesses 411 recesses upward, which contributes to a rib effect with respect to deflection of the sandwich panel 4 in its longitudinal direction. The lower metal skin 41 may be made of, for example, galvanized steel sheet, coated steel sheet, Galvalume steel sheet (registered trade-mark), SGL (registered trade-mark), and stainless steel sheet.

[0021]

The upper metal skin 42 has a width in the beam direction and a length in the ridge direction. An upper surface of the upper metal skin 42 constitutes a roof surface of the building structure. The upper metal skin 42 is placed above the lower metal skin 41 with being spaced at a certain interval. The upper metal skin 42 may be made of, for example, galvanized steel sheet, coated steel sheet, Galvalume steel sheet (registered trade-mark), SGL (registered trade-mark), and stainless steel sheet, as the lower metal skin 41.

[0022]

The upper metal skin 42 has a plurality of protrusions 421 which protrudes upward. Each of the plurality of protrusions 421 elongates in the longitudinal direction of the sandwich panel 4, as illustrated in FIG. 1. Specifically, each of the plurality of protrusions 421 elongates

continuously throughout the longitudinal direction of the sandwich panel 4 (i.e., the ridge direction). The plurality of protrusions 421 are placed at certain intervals along a widthwise direction of the sandwich panel 4.

[0023]

The core 43 is filled between the lower metal skin 41 and the upper metal skin 42. The core 43 may be made of a material having a heat insulating property. The core 43 may be made of a foamable resin excellent in a heat insulating property such as polyisocyanurate foam and hard urethane foam or an inorganic material such as rock wool and gypsum board.

[0024]

As illustrated in FIG. 3, out of both widthwise ends of the sandwich panel 4, a first connecting part 51 is formed on one end and a second connecting part 52 is formed on the other end. The first connecting part 51 and the second connecting part 52 are formed so that the first connecting part 51 and the second connecting part 2 can joint to each other. Due to this, the plurality of sandwich panels 4 are jointed in the beam direction. In the sandwich panels 4 of the present embodiment, a fixing tool 6 is driven from above while keeping the first connecting part 51 and the second connecting part 52 connected so that the sandwich panels 4 are fixed to the flanges 324 of the upper chord 32. The fixing tool 6 is driven to parts of the sandwich panels 4, in the longitudinal direction, which correspond to the upper chord 32. Due to this, the sandwich panel 4 can connect the plurality of beams 3.

[0025]

As explained, in the building structure of the present embodiment, the plurality of support structures 1 are connected by the sandwich panel 4 excellent in the mechanical strength.

Accordingly, the purlins required in a large number in the conventional building structures are not necessary in the building structure of the present embodiment, and the building structure excellent in cost and workability can be obtained. Also, the sandwich panel 4 includes the core 43 having the heat insulating property. Therefore, only by placing the sandwich panel 4 over the beam 3, a roof can gain the heat insulating property without filling space under the roof with heat insulating materials, leading to an improved workability.

[0026]

(Effect)

As explained above, the building structure of the first aspect of the present embodiment

includes: the plurality of support structures 1 and the sandwich panel 4. Each of the plurality of support structures 1 includes the plurality of columns 2 and the beam 3 attached to the plurality of columns 2, wherein the plurality of support structures 1 are placed with being spaced at certain intervals in the ridge direction. The sandwich panel 4 connects the beams 3 of the plurality of support structures 1 placed in the ridge direction with each other.

[0027]

According to the first aspect, since the plurality of support structures 1 are connected by the sandwich panel 4 which is excellent in the mechanical strength, the building structure can have the strength without the purlins.

[0028]

The building structure of the second aspect of the present embodiment has the following additional features. In other words, in the building structure of the second aspect of the present embodiment realized in combination with the first aspect, the beam 3 includes: the pair of truss chords 31 including the upper truss chord and the lower truss chord placed separately; and the plurality of connecting materials 34 which connect the pair of truss cords 31. The sandwich panel 4 is fixed to the upper truss chord 31 (the upper chord 32).

[0029]

According to the second aspect, the deflection of the beam 3 can be prevented effectively.

[0030]

The building structure of the third aspect of the present embodiment has the following additional features. In other words, in the building structure of the third aspect of the present embodiment realized in combination with the first or the second aspect, the sandwich panel 4 includes: the lower metal skin 41 which is fixed to the beam 3; the upper metal skin 42 which is placed above the lower metal skin 41 with being spaced from the lower metal skin 41; and the core 43 provided between the lower metal skin 41 and the upper metal skin 42. The upper metal skin 42 has the protrusion 421 which is the continuous protrusion along the ridge direction and protrudes throughout the ridge direction of the upper metal skin 42.

[0031]

According to the third aspect, the deflection of the sandwich panel 4 in its longitudinal direction can be prevented effectively.

[0032]

(Applied embodiments)

In the above embodiment, the steel truss beam 3 functions as the beam 3; however, an H-shaped steel may be used as the beam 3.

[0033]

In the above embodiment, the sandwich panel 4 has the plurality of recesses 411; however, the sandwich panel 4 does not need to have the plurality of recesses 411. Also, in the above embodiment, the sandwich panel 4 has the plurality of protrusions 421; however, the sandwich panel 4 does not need to have the plurality of protrusions 421. In other words, the upper metal skin 42 may be formed flat.

[0034]

In the above embodiment, the longitudinal direction of the protrusions 421 is parallel to the ridge direction; however, the protrusion 421 may be formed in a direction parallel to the longitudinal direction of the beam 3. Also, the sandwich panel 4 may be an incline. In this case, the sandwich panel 4 may incline in a direction parallel to the longitudinal direction of the protrusions 421.

[0035]

Note that details and designs of the above explained embodiment can be appropriately modified within the subject matters of the present invention.

Reference Signs List

[0036]

- 1 Support structure
- 2 Column
- 3 Beam
- 31 Truss chord
- 34 Connecting material
- 4 Sandwich panel
- 41 Lower metal skin
- 42 Upper metal skin
- 421 Protrusion
- 43 Core

CLAIMS

1. A building structure comprising:
 - a plurality of support structures each including a plurality of columns and a beam attached to the plurality of columns, wherein the plurality of support structures are placed with being spaced at certain intervals in a ridge direction; and
 - a sandwich panel which connects the beams with each other.
2. The building structure according to claim 1, wherein the beam includes:
 - a pair of truss chords including an upper truss chord and a lower truss chord placed separately; and
 - a plurality of connecting materials which connect the pair of truss chords, and the sandwich panel is fixed to the upper truss chord.
3. The building structure according to claim 1 or 2, wherein the sandwich panel includes:
 - a lower metal skin which is fixed to the beam;
 - an upper metal skin which is placed above the lower metal skin with being spaced from the lower metal skin; and
 - a core provided between the lower metal skin and the upper metal skin, and the upper metal skin has a protrusion which is a continuous protrusion along the ridge direction and protrudes throughout the ridge direction of the upper metal skin.